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IS 13914 (1993): Code of safety for perchlorates of ammonium, potassium and sodium [CHD 8: Occupational Safety, Health and Chemical Hazards]

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आमोनियम पोटाशियम एंव सोडियम की सुरक्षा संहिता

Indian Standard

PERCHLORATES OF AMMONIUM, POTASSIUM AND SODIUM — CODE OF SAFETY

UDC 662 222 22/24 614 878

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

***December* 1993** **Price Group 3**

Chemical Hazards Sectional Committee, CHD 007

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council

Ammonium perchlorate is used in the manufacture of commercial explosives and propellants.

Potassium perchlorate's principal use is as an oxidizer in fuels for military rockets It is also used in explosives, fireworks, flares and railway signals

Sodium perchlorate's principal use is as an intermediate in the manufacture of most perchlorates and perchloric acid on industrial scale

Most of the perchlorates are white crystalline solids, explosive and may cause irritation to skin

In preparation of this code of safety, considerable assistance has been derived from the following publications

i) Encyclopedia of Chemical Technology by Raymond E Kirk and Donald F Othemer

ii) Dangerous properties of Industrial Materials by N Irving Sax, Sixth Edition

iii) Chemistry and Technology of Explosives Vol IV by T Urbanski

iv) Explosives by Rudlof Meyer

The composition ot the technical committee responsible for the formulation of this standard is given at Annex A

AMENDMENT NO. 1 MARCH 2002
TO
IS 13914 : 1993 PERCHLORATES OF AMMONIUM, POTASSIUM AND SODIUM — CODE OF SAFETY

(*First cover page Hindi title*) — Substitute the following for the existing

अमोनियम, पोटाशियम एवं सोडियम के परक्लोरेट —
सुरक्षा संहिता

(*Page* 1 *clause* 1 *line* 2) — Substitute perchlorate *for* prechlorates

(*Page* 1 *clause* 41 *line* 8) — Insert and between the words ketones and ether

(*Page* 2 *clause* 4 4 3 3) — Substitute the following for the existing

4 4.3.3 *Melting Point* — 480°C (water free product)

(CHD 7)

Reprography Unit BIS New Delhi India

Indian Standard

PERCHLORATES OF AMMONIUM, POTASSIUM AND SODIUM — CODE OF SAFETY

1 SCOPE

This standard prescribes code of safety concerning hazards relating to prechlorates (ammonium, potassium and sodium) It describes properties and other information for safe handling of perchlorates

Though this code does not deal with specification for the design of building, chemical engineering, plant and equipment for waste disposal general precautionary measures in these respects should be taken

2 REFERENCE

IS 4155 1966 Glossary of terms relating to chemical and rediation hazard and hazardous chemicals is a necessary adjunct to this standard

3 TERMINOLOGY

For the purpose of this standard definitions given in IS 4155 1966 shall apply

4 PROPERTIES

4 1 General Information

Most of the perchlorates are white crystalline solids They are dimorphus in character and isomorphus with permanganates In general the perchlorates that crystallize as hydrates are very soluble in water and deliquescent whereas those that do not form hydrates are relatively insoluble and are not deliquescent As a rule perchlorates are soluble in organic solvents particularly in alcohols ketones ether There are a number of perchlorates that have a greater solubility in organic solvents than in water

4 2 Ammonium Perchlorate

4 2 1 *Formula*— NH_4ClO_4

4 2 2 *Molecular Weight* — 117 5

4 2 3 *Physical Properties*

4 2 3 1 *Description* — Colourless or white crystals

4 2 3 2 It is dimorphus that is two crystal structures of ammonium perchlorate are known the lower temperature orthorhombic form exists below 240°C while cubic form exists above 240°C

4 2 3 3 *Melting point* — Decomposition by heating

4 2 3 4 *Density*

a) Orthorhombic — 1 95 g/cm^3
b) Cubic — 1 76 g/cm^3

4 2 3 5 *Specific heat* — 0 309 cal/g C between 15 and 240°C and 0 365 cal/g °C above 240°C

4 2 3 6 It is nonhygroscopic

4 2 3 7 Soluble to the extent of about 20 g/1 in water at 15°C and is sparingly soluble in alcohol and acetone

4 2 4 *Chemical Properties*

4 2 4 1 It is prepared by neutralising ammonia by perchloric acid It is purified by crystallization

4 2 4 2 On a commercial scale it is prepared by the interaction of ammonium chloride with sodium perchlorate

4 2 4 3 Unlike alkali perchlorates it has the advantage of being completely convertible to gaseous reaction products

4 2 4 4 Ammonium perchlorate is stable at room temperature It begins to decompose at 130°C or 150°C and deflagrates at 400°C with evolution of light Some of the material sublimes when the decomposition is carried out slowly At higher temperature the decomposition is explosive Numerous products such as chlonne dioxide (at temperature below 300°C) nitrogen water oxygen nitrous oxide hydrogen chloride nitrosyl chloride nitrogen trioxide and nitrogen dioxide are formed during the decomposition The latter compounds being the result of the secondary reaction of nitric oxide with chlorine and oxygen

4 2 4.5 It gives the reactions of NH_4+ when a solution is tested It also gives the specific reaction of perchlorate radical when tested

4 2 5 *Explosive Properties*

4 2 5 1 *Enthalpy of formation* —602 kcal/g = 2 518 kJ/kg

4.2 5 2 *Heat of explosion* (H_2O *Kg)* — 488 kcal/g (2 045 kJ/kg)

4 2 5 3 *Deflagration point* — 350°C (662°F)

4 2 5 4 *Lead black expansion* — 195 cm^3

4 2 5 5 *Volume of detonation gases* —803 1/kg

4 2 5 6 *Impact sensitivity* — 15 kpm (15 Nm)

4 3 Potassium Perchlorate

4 3 1 *Common Name and Chemical Name* — Potassium perchlorate

4 3 2 *Formula* — $KClO_4$

4 3 3 *Molecular Weight* — 138 55

4 3 4 *Physical Properties*

4 3 4 1 *Description* — Colourless or white crystals or powder

4 3 4.2 *Melting Point* — 610°C ± 10°C

4 3 4 3 *Density* — 2 52 g/cm^3

4 3 4 4 Insoluble in alcohol but soluble in water

4 3 5 *Chemical Properties*

4 3 5 1 It gives the reactions of K^+ radical when a solution is tested It also gives the specific tests of perchlorate radical

4 3 5 2 It is prepared by reacting a soluble potassium salt with sodium perchlorate or perchloric atid

4 4 Sodium Perchlorate

4 4 1 *Formula* — $NaClO_4$

4 4 2 *Molecular Weight* — 122 45

4 4 3 *Physical Properties*

4 4 3 1 *Description* — colourless or white crystals

4 4 3 2 *Density* — 2 5 g/cm^3

4 4 3 3 *Melting Point* — 482°C (900°F) (water free product)

4 4 3 4 Sodium perchlorate is hygroscopic and readily soluble in both water and alcohol

4 4 4 *Chemical Properties*

4 4 4 1 It gives the reactions of Na^+ radicals as well as that of perchlorate radical when a solution is tested

4 4 4 2 Sodium perchlorate is produced by electrolysis of a concentrated solution of sodium chlorate

4 5 Fire and Explosion Hazards

4 5 1 *Fire Hazards*

Perchlorates are powerful oxidizers When exposed to heat/fire the perchlorates decompose to emit toxic fumes

4 5 2 *Explosion Hazards*

Perchlorates are considered as fire and explosion hazard When associated with carbonaceous materials or finely divided metal powder or sulphur powdered magnesium and aluminium form explosive mixtures They react violently with benzene calcium hydride charcoal olefins strontium hydride and sulphuric acid

5 TOXICITY INFORMATION AND HEALTH EFFECTS

5 1 Perchlorates are unstable materials and are irritants to the skin and mucus membrane of the body Avoid skin contact with these materials

Perchlorates may cause reversible or irreversible changes to exposed tissue not permanent injury or death may cause considerable discomfort by chemical reaction

5 2 Summary Toxic Statement

5 2 1 *Ammonium Perchlorate*

Irritant to the skin and mucus membrane has been indicated in a plastic anemia Absorption may cause methemoglobinemia and kidney injury

5 2 2 *Potassium Perchlorate*

Irritant to the skin and mucus membrane has been indicated in a plastic anemia Absorption may cause methemoglobinemia and kidney injury

5 2 3 *Sodium Perchlorate*

May cause considerable discomfort via intrapentoneal route

5 2 3 1 *Acute toxic data*

Intraperitoneal LD_{50} mice = 551 mg/kg

6 PERSONAL PROTECTIVE EQUIPMENT

Protective equipments should include use of self contained breathing apparatus in case of fire involving perchlorates Rubber gloves safety goggles and protective clothing should be used while handling perchlorates

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7 1 Storage

7 1 1 The most important fact to remember in handling perchlorates is that they are powerful oxidizing agent and when exposed under impart or when exposed to excessive heat and fire they also form explosives with combustible substances They should therefore be stored in covered godowns having light roots at safe distance from the main plant and buildings The provisions of the Explosives Act and Rules notified thereunder should also be complied with

7 1 2 All room where perchlorates are stored shall be fire resistant and be provided with adequate ventilation Surrounding area should be free from vegetation

7 1 3 All electrical wirings light fittings motors etc and other equipments installed or used where perchlorates are stored or handled shall be essentially flame and dust proof type only All plant and machinery handling perchlorates should be effectively earthed for controlling of undesirable static electricity

7 1 4 Bulk storage areas should be away from all sources of open flame heaters furnaces and welding or other flame or spark producing equipments NO SMOKING signs shall be conspicuously displayed in the area

7 1 5 It is desirable to have water sprinklers around the storage yard to keep the containers cool in the event of fire

7 2 Handling

7 2 1 Perchlorates are difficult to ignite and will detonate only on powerful impulse but nevertheless they must be handled with care

7 3 Labeling

7 3 1 Hazard warning symbols labels shall be displayed in plant areas Cautionary/warning notices such as NO SMOKING and Naked flame strictly prohibited may be displayed

7 3 2 Labels in containers should be in accordance with prevailing regulations namely Manufacture Storage and Import of Hazardous Chemicals Rules 1989 and Explosives Act and Rules made thereunder

7 4 Transport

7 4 1 Personal protective wears such as suit gloves goggles and boots shall be used while handling and transporting perchlorates

7 4 2 Perchlorates may be transported in steel containers with plastic linear inside of approved design and construction as per instructions laid down

7 4 3 Presence ot naked flame and smoking should not be allowed in the area

7 4 4 Well ventilated locations must be chosen for the loading and unloading operations

7 4 5 The containers should not be dropped during handling

8 SPILLAGE/LEAKAGF AND WASTF DISPOSAL

There should be adequate arrangement for collection of spills/wastes for safe disposal The empty/used liners should be free from vegetaion

9 FIRE PREVENTION AND FIRF FIGHTING

9 1 Avoid contact with carbonaceous materials and pervent perchlorates from heat and fire

9 2 Use water or foam extinguisher for fighting fire involving perchlorates

10 TRAINING AND HEALTH MONITORING

10 1 Training

Safety in handling perchlorates depends to a great extent upon the effectiveness of employees education proper safety instructions intelligent supervision and the use of safe equipment

10 2 Health Monitoring

Provide regular medical monitoring of those exposed to perchlorate in the work place

11 SAFEY OF PFRSONAL

No person shall be employed in plant handling perchlorates unless he has received training and has been provided with detailed instructions Material Safety Data Sheets (MSDS) should be available at sites dealing with perchlorates

12 FIRST AID

12 1 Skin Contact

Wash area of contact with soap and water If irritation persists get medical attention

12 2 Fye Contact

Immediately wash with plenty of water including under the eyelids If irritation persists get medical attention

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Chemical Hazards Sectional Committee CHD 007

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SHRI K D SHARMA	Directorate General of Technical Development New Delhi
SHRI C D BANKAR (*Alternate*)	
DR M SENGUPTA	Ministry of Environment & Forests New Delhi
DR (MRS) INDRANI CHANDRASEKARAN (*Alternate*)	
DR P K SETH	Industrial Toxicology Research Centre Lucknow
DR P N VISWANATHAN (*Alternate*)	
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SMT SUNITA KUMAR	Development Commissioner Small Scale Industries New Delhi
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DR A K. SAXENA (*Alternate*)	
DR R. K SINGH Director (Chem)	Director General BIS (*Ex officio Member)*

Member Secretary
SHRI T RANGASAMY
Join, Director (Chem)

(*Continued on page* 5)

(*Continued from page 4*)

Miscellaneous Hazards Subcommittee CHD 007 05

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